In the Specification

Page 1, change the title to:

Apparatus for determining temperance of and controlling the evaporation of liquid samples

Page 2, lines 22 - 23:

The processing means may convert the sensor output signals into digital or ~~analogue~~ analog signals by which a carrier signal is modulated to effect the said transmission.

Page 4, lines 5-9:

Preferably any rotational electrical connection is separated from ~~vapours~~ vapors in the chamber by being located outside the chamber, or inside the signal processing means housing, and seals are provided around conductors leading between the signal processing means and the external electrical connection where they pass through the wall of the chamber or the housing.

Page 4, lines 16 - 17:

Preferably material from which the housing is constructed, is non-conductive as well as being inert in the presence of the ~~vapours~~ vapors given off during the evaporation process.

Page 5, lines 24 - 26:

The signal processing means is preferably housed in a leak-tight housing to protect the electronic components making up the processing means from pressure fluctuations and from the ~~vapours~~ vapors arising from evaporation in the chamber.

Page 7, lines 11 - 18

Thus measurement can be achieved as desired, by inserting a temperature sensor into one of the samples and connecting it to a suitable electronic processor and transmitter, preferably located at the ~~centre~~ center of rotation of the sample holder.

This sensor can be a thin thermocouple sheathed in an impervious inert material such as PTFE so that it will not contaminate the sample or suffer corrosion.

The processor preferably amplifies and converts the output of the thermocouple to a digital or ~~analogue~~ analog signal, which is transmitted through the container, into the vacuum chamber, and is picked up by an external receiver.

Page 8, line 20 - page 9, line 10:

When the sample liquid is evaporating, the pressure in the evaporator chamber approximates to the ~~vapour~~ vapor pressure of the liquid or liquids in the chamber at the temperature of the liquid or liquids concerned and the chamber pressure can therefore be used as an indication of sample temperature.

The invention therefore also provides a method of determining the temperature of evaporating liquid samples contained or comprising at least one rotatable component and contained in at least some of a plurality of individual sample holders which are mounted within a chamber and rotated during the evaporation process so that centrifugal force is exerted on volatile liquid contained therein, and wherein heat is supplied to the sample holders to heat the volatile liquid therein whilst a pressure below atmospheric is maintained in the chamber in manner known per se, which is ~~characterised~~ characterized by the location of a pressure sensing device in the chamber, sensing the pressure therein at least during the evaporation process, generating an electrical pressure data signal which is proportional to the sensed

pressure, conveying along a signal path the pressure data signal to electronic data signal processing means which is programmed inter alia with information relating to the volatile component or components present in the samples, to convert the pressure data signal to a temperature value equal to that which equates to the measured ~~vapour~~ vapor pressure for the known volatile component or components present.

Page 10, lines 15 - 20:

Where the heat is infra-red radiation, a heat absorbing screen is preferably located between the source of the infra-red heat and the samples, having a plurality of radiation conductive regions therein, each conductive region aligning with the position of one of the samples in the array of samples, and the thermal transmissivity of the regions increase towards the ~~centre~~ center of the array so that samples located in the central region of the array receive more radiation per unit time than those in peripheral regions of the array.

Page 11, lines 18 - 27:

The invention also lies in a method of controlling the heating of samples within a centrifugal evaporator wherein the samples are contained within a pressure vessel which is progressively evacuated by a vacuum pump so as to assist in the evaporation of the liquid from the samples, wherein a ~~vapour~~ vapor condenser is employed to increase the pumping speed to protect the vacuum pump from ~~vapour~~ vapor emitted during the evaporation process and wherein there is provided means for measuring ~~vapour~~ vapor flow rate, and method of control involves controlling the energy to the heater in response to a signal derived from the flow rate measurement such that as the flow rate decreases, the heating energy is decreased, and as the ~~vapour~~ vapor flow rate approaches zero, indicating that the samples are all dry, the heat energy is shut off.

Page 12, line 18 - page 14, line 1:

~~The invention will now be described by way of example, with reference to the accompanying drawings comprising figures 1 to 8."~~

~~Figure 1 illustrates a centrifugal evaporator embodying the invention described and claimed herein."~~

--Brief Description of the Drawings

The invention will now be described by way of example, with reference to the accompanying drawings in which:-

Figure 1 illustrates a centrifugal evaporator embodying the invention described and claimed herein.

Figure 2a depicts the strong infrared radiation from above.

Figure 2b depicts the strong heat from the side.

Figure 3 depicts a metal screen that is located between the sample holders and the heat source.

Figure 4 depicts an arrangement of shelves or trays.

Figure 5 illustrates a microtit4e plate.

Figure 6 illustrates a side view of a microtitre plate above an aluminum support.

Figure 7 shows the monitoring system for the chamber shown in Figure 1.

Figure 8 shows the system according to the invention.

Detailed Description of the Invention -

The samples in Figure 1 are contained in blocks ~~(4)~~ 4 in which there are numerous sample wells (not shown), commonly referred to as deep well microtitre blocks.

When the sample holder rotor 5A and shaft 5B rotates, driven by a motor 5C, which may be inside but more usually external to the chamber ~~(14)~~ 14, the sample blocks swing out to the position illustrated in which the sample wells are horizontal, under the influence of centrifugal force.

The sample blocs are connected to pivots ~~(13)~~ 13 and the blocs are held with the wells vertical for loading into a stationary evaporator. Vacuum is then applied to the evaporator chamber ~~(14)~~ 14 via pipe ~~(9)~~ 9 from the ~~vapour~~ vapor condenser which in turn is pumped via pipe ~~(10)~~ 10 by the vacuum pump.

Heat is applied to the rotating sample blocks ~~(4)~~ 4 by a high temperature infra-red radiation source ~~(1)~~ 1, and radiant heat energy ~~(2)~~ 2 passes through a window of heat-transparent material such as quartz which is sealed into the wall of the vacuum chamber ~~(14)~~ 14 and reaches the sample holder as illustrated.

A temperature sensor or probe ~~(15)~~ 15 is placed in one of the sample wells, or otherwise placed in close proximity to the wells in one of the sample blocks, and is connected to transmitter ~~(11)~~ 11 which transmits signals corresponding to the sample temperature to an aerial feedthrough ~~(6)~~ 6 inside and extending through the chamber wall, and which is connected to a receiver and decoder ~~(16)~~ 16. This includes data processing and computing facilities as required, can be programmed to generate electrical signals to control the operation of the heather increase or decrease the heat energy to keep the samples at desired temperatures during the process. Such control signals are supplied to the heater via path 17.

Sample temperature uniformity

It is important that as far as possible all the samples are evaporate at the same rate. To achieve this all samples should receive the same heat input by directing the heat to them, so as to heat all the sample containing tubes uniformly. A common form of sample holder is a deep-well microtitre plate ~~(20)~~, in which typically there are 96 wells.

The plate is mounted on swivel pins (not shown in Figure 2) so that when it is initially loaded onto a stationary rotor 5A the open ends of the wells face upwards, but as soon as the rotor 5A is rotated at a sufficient speed, the plates or blocks ~~(4)~~4 swing into a position in which the wells are horizontal, as is in the fact shown in Figure 1, and in Figure 2.

Page 14, line 12 - Page 15, line 6:

Cold ~~neighbour~~ neighbor effect

Even with perfectly uniform heat input the samples will not evaporate at a uniform rate because of "cold ~~neighbour~~ neighbor effect". If the samples are in thermal contact with each other as is the case for example in a micrtitre plate or block ~~(4)~~4, the outer samples only have evaporating (and therefore "cold") ~~neighbours~~ neighbors on three or (corner samples) two sides; and therefore do not lose as much heat to their ~~neighbours~~ neighbors as those in the ~~centre~~ center which have four " cold" ~~neighbours~~ neighbors . Also, two of an outside sample's ~~neighbours~~ neighbors will generally be less cold than those of the inner samples. Outside samples therefore can evaporate faster than centrally located samples.

As provided by another aspect of the invention, this effect can be reduced or eliminated by reducing the heat input to the outer samples, and in the (preferred) infra-red heating case, a simple way of doing this is to provide graduated shading from the infra red beam by, for example, placing a metal screen [[19]] 18 (see Figure 3)

between the sample holder and the heat source. The screen contains graduated perforations 20,22, 24, so that those in the outer region transmit much less radiation than do those in the central region, and those in intermediate regions, such as 22, which have an intermediate size thereby transmit greater quantities of heat than do the outer ones 20. The inner opening 24 allows an uninterrupted path for radiation to the ~~centre~~ center of the array of the sample holders.

Although the sample holder ~~(4)~~ 4 illustrated is described as being a deep-well microtitre block or plate, the same techniques may be employed to obtain uniform temperature and graduated heating as described above, when using arrays of tubes, bottles or vials in holders which swing out on swivels in a similar manner.

Page 15, line 14 - page 16, line 6:

~~Vapour~~ Vapor flow

A ~~vapour~~ vapor condenser is shown at 26 in Figure 1. These devices are used in centrifugal evaporation equipment to increase pumping speed for the liquid being evaporated and to protect the vacuum pump 28 from ~~vapours~~ vapors which might impair its efficiency. Such condensers are vessels held at low temperatures at which the ~~vapours~~ vapors being evaporated condense or solidify.

If a ~~vapour~~ vapor condenser 26 is located between a vacuum pump 28 and an evaporation chamber 14 as shown in Figure 1, the pressure in the chamber 14 cannot be reduced below the ~~vapour~~ vapor pressure of any condensed liquid remaining in the condenser 26. This is due to the evaporation of condensed material which will take place in the condenser if the system pressure is reduced to a level approaching the ~~vapour~~ vapor pressure of the condensed material left in the condenser 26. This phenomenon, especially if a more volatile material has been left in the condenser 26 from a previous run, can make chamber pressure a rather insensitive technique for sensing sample temperature at the end of evaporation to indicate when the samples

are dry, and it may be unreliable as a means for determining when the equipment can be shut down.

According to another aspect of the invention, the measurement of ~~vapour~~ vapor flow rate has been proposed as a more useful monitor of the evaporation process.

Page 17, lines 5 - 8:

Such an arrangement of shelves or trays is shown in Figure 4. This is formed from a supporting frame comprising a heavy aluminium base [[9]] 29 and similar heavy aluminium ends 30, 32 (the later being shown as transparent in the Figure) with trays 34, 36, 38 etc spanning the gap between the ends 30, 32.

Page 17, lines 20 - 26:

Figure 7 shows the important components of the monitoring system for a chamber such as shown in Figure 1. Each probe 15 connects to an input of a signal processor 50, the output of which is ~~digitised~~ digitized by an A/D converter 52 for supply to a microprocessor 54 which handles the modulation of a radio signal in a transmitter 56 to which signals are supplied from the microprocessor for radiation by an antenna 58. A power supply 60 may comprise a battery. Except for the probe 15 and antenna 58, all the units shown in Figure 7 may be housed within a housing located on the sample holder rotor 5A.